Two Dogmas about Newton and Space

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In definitions written for possible inclusion in the third edition (1726) of Book III of the Principia, Newton defined both "body" and "vacuum" in terms of resistance: body is that which gives resistance, vacuum is the place in which body can move without resistance. Curiously, Newton is vehement that these definitions are not the only possible definitions of body and vacuum, but are merely the ones with which he is concerned in the Principia. About "other sorts of bodies and another sort of void", he writes, "let authors in other sciences dispute". This admission is stunning. Throughout his career—beginning with *De Gravitatione*'s metaphysics of void space as a necessary emanation of God, to the revisions of the corporeal transmutation hypothesis of the Principia's first edition, to the draft definitions mentioned above—Newton had struggled with the concepts of body and void. During this time, he had often claimed that his concept of body is suited only to the project of the Principia—-other physical theories may hypothesize other sorts of bodies—-yet until these draft definitions, he had never done so for the concept of void. In fact, in the earlier De Gravitatione, he even portrayed his account of void space as the only metaphysically possible one!

By analyzing these draft definitions in conjunction with *De Gravitatione* and changes in the scholium on space and time, I argue that Newton's notion of absolute, void space underwent a subtle change from the time of De Gravitatione to the 1720s. In particular, I argue that Newton started to question whether space was necessarily inert. This change implies that Newton was close to rejecting the conception of space expressed in De Grav, the same conception that in contemporary literature is often presented as the Newtonian view of space. Furthermore, I show that the change in Newton's conception was due to his increased subsumption of the concept of space under the framework of his empiricist methodology, a framework according to which the definitions of physical concepts cannot stand independently of and prior to the physical theory they found. Newton's changing concept of void space thus challenges two related theses that condition many contemporary accounts of 'Newtonianism': First, that Newton's philosophical views did not develop in the course of his career; in particular, that De Gravitatione expresses Newton's mature Neo-Platonist-inspired metaphysics. And second, that Newton was a uncompromising absolutist about space until his dying day, i.e., that he intended to draw necessary and metaphysical conclusions about the nature of space from his physical theory.

These claims are supported by two threads of argumentation. First, I show that Newton's conception of space in both De Gravitatione and the scholium to the definitions of the Principia was supported by two mostly independent sets of arguments: one concern among the geometrical structure of space and its necessity for a coherent physical theory, and the other concerning the lack of agency of space. Although the two sets of arguments are intertwined in Newton's presentation and constitute the "standard" view of Newtonian space-time, they are methodologically independent. While the first concerns the conceptual basis of the fundamental concepts of physical theory (e.g., velocity of motion, time of motion, etc.), the second concerns direct empirical evidence regarding the vacuity of the celestial spaces and the aetherial resistance encountered by projectiles. Because of this methodological independence, when in the 1710s Newton came to doubt the validity of his arguments concerning the vacuity of the celestial spaces (expressed in revisions to Prop. 6 of Book III of the Principia), he could question whether space was necessarily inert without questioning space's necessity and essentially geometrical structure. This comprised Newton's first move towards the rejection of his earlier concept of space. However, even if Newton's two sets of arguments were methodologically independent, they were not independent in

substance. Their link centers on the necessity of space for physical theory. Through the first set of arguments, Newton showed that the geometrical structure of absolute space is conceptually necessary for the basic concepts of physical theory. However, it is through the second set of arguments that Newton showed that space is "neither substance nor accident" and so ontologically necessary, i.e., a necessary emanation of God. Consequently, I argue, Newton's doubts concerning the agency of space directly undermine De Gravitatione's conception of space as both conceptually and ontologically necessary.

The second thread of argumentation concerns Newton's preferred method of reasoning in natural philosophy. From De Gravitatione to the drafts of the third edition of the Principia, Newton held that his preferred method is "the method of the geometers". On this method, terms in natural philosophy ought to be used only in accordance with their precise definitions. Their vulgar use, if it exists, ought to be ignored. However, as I will show, in De Gravitatione and the scholium to the definitions Newton consciously avoided using this method in his treatment of space. In fact, he explicitly held that since "time, space, place, and motion" are "very well known to all", he shall not define them! Rather, in order to treat space Newton followed a more common mode of natural philosophical argumentation: he took a familiar (if not precise) concept and showed through a series of arguments what could and could not be properly said of it. It is as part of this strategy that Newton discussed the necessity, geometrical character, and lack of agency of space. For Newton, these were characteristics of space that had been tacitly assumed by all previous commentators, although previous commentators had not always come to see them clearly. For Newton, his concept of space was thus the same as that of his predecessors, but cleansed of their errors and misconceptions. Yet Newton's treatment of space changed radically in the 1710s. During this period, after coming to doubt the agency of space, Newton came to believe that void space itself (along with body) must be subjected to "the method of the geometers". On Newton's understanding of this method, however, foundational theoretical terms (like "space") are not defined a priori. Rather, they are defined through the machinery of a posteriori physical theory and gain their foundational status by their role in that theory. It is because Newton began to bring his concept of space under this general methodology that the concept ceased (for him) to have a general, metaphysical application, and be limited to discussions bounded by the framework of the Principia.

By considering Newton's method of defining concepts in natural philosophy and its intertwining with his changing views on the nature of space, I aim to portray Newton as a historically developing philosopher. Precisely, I aim to show that although in his De Gravitatione he was a "hardcore" absolutist, his position regarding the metaphysical necessity of space evolved to be much weaker than it is usually supposed to be.